CLAIMS

What is claimed is:

1. A cardiac isolation catheter insertable within the vena cava of a mammal, said catheter comprising

(a) a hollow tubular body having a venous blood flow lumen extending longitudinally therein, a proximal end, a distal end, a proximal port, and a distal port;

(b) a distal vessel seat attached to said body; and

(c) a proximal vessel seat attached to said body;

wherein said cardiac isolation catheter is positionable within the vena cava of the mammal such that one vessel seat is positioned in the superior vena cava of the mammal between the right atrium and the junction of the brachiocephalic veins and the other vessel seat is positioned in the inferior vena cava between the right atrium and the hepatic veins,

wherein said distal port is located distally with respect to said distal vessel seat, and

wherein said proximal port is located proximally with respect to said proximal vessel seat,

whereby blood in the junction of the brachiocephalic veins and blood in the hepatic veins is in fluid communication with said venous blood flow lumen by way of said ports.

2. The cardiac isolation catheter of claim 1, wherein at least one of said distal vessel seat and said proximal vessel seat comprises a raised surface extending circumferentially about said body.

3. The cardiac isolation catheter of claim 2, wherein said vessel seat comprises a pair of closely-spaced raised surfaces, whereby the vena cava may be securely seated at said vessel seat by ensnaring the vena cava between said pair of raised surfaces.

4. The cardiac isolation catheter of claim 2, wherein said vessel seat comprises a pair of closely-spaced raised surfaces, and wherein said body has a suction lumen extending longitudinally therein and communicating with a suction port situated between said pair of closely-spaced raised surfaces, whereby the vena cava may be securely seated at said vessel seat by application of suction to said suction lumen.

5. The cardiac isolation catheter of claim 2, wherein at least one of said distal vessel seat and said proximal vessel seat is expandable.

6. The cardiac isolation catheter of claim 5, wherein said expandable vessel seat comprises a balloon attached to said body and having an interior which communicates with an inflation lumen extending longitudinally in said body, whereby the vena cava may be securely seated at said vessel seat by expanding said balloon after positioning said catheter in the vena cava of the mammal.

7. The cardiac isolation catheter of claim 6, wherein both of said distal vessel seat and said proximal vessel seat are balloons attached to said body and having interiors which communicate with said inflation lumen.

8. The cardiac isolation catheter of claim 1, wherein said body has an access lumen extending longitudinally therein and an access port positioned between said distal vessel seat and said proximal vessel seat, wherein said access port communicates with said access lumen.

9. The cardiac isolation catheter of claim 8, further comprising a second catheter having a distal end, said second catheter being positionable within said access lumen, whereby said second catheter can be urged through said access port.

10. The cardiac isolation catheter of claim 9, wherein the distal end of said second catheter comprises a curved portion for positioning said distal end of said second catheter within the pulmonary artery of said mammal.

11. The cardiac isolation catheter of claim 10, wherein the distal end of said second catheter is adapted to the shape of a human heart.

12. The cardiac isolation catheter of claim 9, wherein the distal end of said second catheter has a deformable portion for positioning said distal end of said second catheter within the pulmonary artery of said mammal.

13. The cardiac isolation catheter of claim 12, wherein said second catheter is a wire-wrapped catheter.

14. The cardiac isolation catheter of claim 9, wherein said second catheter comprises a pulmonary balloon at the distal end thereof, whereby the pulmonary artery of the mammal may be blocked by inflating said pulmonary balloon therein after positioning the distal end of said second catheter in the pulmonary artery.

15. The cardiac isolation catheter of claim 13, wherein said second catheter has a pressure relief lumen extending longitudinally therein and a right ventricle pressure relief port in fluid communication with the pressure relief lumen.

16. The cardiac isolation catheter of claim 1, wherein said body has a fluid flow lumen extending longitudinally therein and a right atrium fluid access port located in said body between said distal vessel seat and said proximal vessel seat.

17. The cardiac isolation catheter of claim 16, wherein said body has a plurality of right atrium fluid access ports circumferentially arranged about said body.

18. The cardiac isolation catheter of claim 1, further comprising at least one non-invasively detectable marker.

19. A surgical kit comprising the cardiac isolation catheter of claim 1.

20. A kit for isolating the heart of a mammal from the rest of the circulatory system of the mammal, said kit comprising

(a) cardiac isolation catheter insertable within the vena cava of a mammal, said catheter comprising

(i) a hollow tubular body having a venous blood flow lumen extending longitudinally therein, a proximal end, at least one access lumen extending therein from said proximal end, a distal end, a proximal port, and a distal port;

(ii) a distal vessel seat attached to said body; and

(iii) a proximal vessel seat attached to said body;

wherein said cardiac isolation catheter is positionable within the vena cava of the mammal such that one vessel seat is positioned in the superior vena cava of the mammal between the right atrium and the junction of the brachiocephalic veins and the other vessel seat is positioned in the inferior vena cava between the right atrium and the hepatic veins,

wherein said distal port is located distally with respect to said distal vessel seat, and

wherein said proximal port is located proximally with respect to said proximal vessel seat,

whereby blood in the junction of the brachiocephalic veins and blood in the hepatic veins is in fluid communication with said venous blood flow lumen by way of said ports;

(b) a second catheter insertable within said access lumen of said cardiac isolation catheter, said second catheter having a distal portion and an inflation lumen extending longitudinally therein and comprising a balloon on the distal portion thereof, wherein the interior of said balloon of said second catheter is in fluid communication with said inflation lumen of said second catheter; and

(c) an endoaortic catheter comprising a flexible rod having a distal portion and a distal tip, and an aortic vessel seat attached to the distal portion of said flexible rod.

21. The kit of claim 20, wherein said aortic vessel seat is attached to said flexible rod at the distal tip thereof.

22. The kit of claim 18, wherein said aortic vessel seat comprises a raised surface extending circumferentially about said flexible rod.

23. The kit of claim 19, wherein said aortic vessel seat comprises a pair of closely-spaced raised surfaces, whereby the aorta may be securely seated at said vessel seat by ensnaring the aorta between said pair of raised surfaces.

24. The kit of claim 19, wherein said aortic vessel seat comprises a pair of closely-spaced raised surfaces, and wherein said flexible rod is hollow and has a suction lumen extending longitudinally therein and communicating with a seating port situated between said pair of closely-spaced raised surfaces, whereby the aorta may be securely seated at said vessel seat by application of suction to said suction lumen.

25. The kit of claim 18, wherein said aortic vessel seat is expandable.

26. The kit of claim 22, wherein said flexible rod is hollow and has an expansion lumen extending longitudinally therein and wherein said aortic vessel seat comprises a balloon attached to said flexible rod and having an interior which communicates with the expansion lumen, whereby the aorta may be securely seated at said aortic vessel seat by expanding said balloon after positioning the distal portion of said endoaortic catheter in the aorta of the mammal.

27. The kit of claim 23, wherein said balloon is not located at the distal tip of said flexible body, and wherein said flexible body has a liquid access lumen extending longitudinally therein and a liquid access port located on the distal portion of said flexible body, wherein said liquid access port is in fluid communication with the liquid access lumen and is located nearer the distal tip of said flexible body than is said balloon.

28. The kit of claim 20, wherein said second catheter has a fluid uptake lumen extending longitudinally therein and a fluid uptake port on the distal portion of said second catheter, wherein said fluid uptake port communicates with said fluid uptake lumen.

29. The kit of claim 20, further comprising

(d) a cannula for insertion into a femoral artery of the mammal, said cannula having an arterial blood flow lumen extending longitudinally therein.

30. The kit of claim 29, further comprising

(e) a pump for withdrawing blood from the venous blood flow lumen of said cardiac isolation catheter and providing blood to the arterial blood flow lumen of said cannula; and

(f) a blood oxygenator for oxygenating blood removed from the mammal.

31. The kit of claim 30, further comprising

(g) an azygous vein occluder.

32. The kit of claim 31, wherein said azygous vein occluder is selected from the group consisting of a hemostat, a cross clamp, a balloon catheter, and a tourniquet.

33. The kit of claim 20, further comprising an inflammatory mediator selected from the group consisting of a vascular permeability-enhancing agent and a vasodilating agent.

34. The kit of claim 33, wherein said kit comprises histamine and papaverine.

35. A method of delivering a macromolecular assembly to a cardiac muscle tissue of a mammal, said method comprising

isolating the cardiac muscle tissue from the systemic circulation of the mammal using the cardiac isolation catheter of claim 1,

providing a vascular permeability-altering agent to a blood vessel associated with the cardiac muscle tissue, and

providing said macromolecular assembly to the vessel, whereby said assembly is delivered to the tissue through the endothelial layer of the vessel.

36. The method of claim 35, wherein said macromolecular assembly is provided to the cardiac muscle tissue by way of an endoaortic catheter.

37. A caval blood uptake kit, said kit comprising a catheter and a pair of vessel seats attached thereto, wherein said catheter has a pair of venous blood uptake ports in communication with a venous blood flow lumen extending longitudinally within said catheter

from said venous blood uptake ports to a proximal portion of said catheter, and wherein said catheter is insertable within the vena cava of a mammal.

38. The caval blood uptake kit of claim 37,

wherein said catheter has a proximal portion, a distal portion, and a distal end,

wherein one of said venous uptake ports and one of said vessel seats are located on the distal portion,

wherein said venous uptake port on the distal portion is located nearer the distal end than said vessel seat on the distal portion,

wherein the other of said venous uptake ports and the other of said vessel seats are located on the proximal portion, and

wherein said vessel seat on the distal portion is located nearer the distal end than said venous uptake port on the distal portion.

39. The caval blood uptake kit of claim 38, wherein said catheter has a notch in the exterior surface thereof, wherein said notch is adapted to fit the body of a second catheter.

40. The caval blood uptake kit of claim 37, further comprising an azygous vein occluder.

41. A caval blood uptake kit, said kit comprising a pair of catheters, wherein each catheter has a vessel seat attached thereto and a venous blood uptake ports in communication with a venous blood flow lumen extending longitudinally therein from said venous blood uptake port to a proximal portion of said catheter, and wherein each catheter is insertable within the vena cava of a mammal.

42. The caval blood uptake kit of claim 41, wherein at least one of said catheters has a notch on the outer surface thereof, wherein said notch is adapted to fit the body of a second catheter.

43. The caval blood uptake kit of claim 41, further comprising an azygous vein occluder.

44. A method of diverting venous blood flow from the vena cavae of a mammal, said method comprising emplacing a catheter within the vena cavae of the mammal, wherein said catheter comprises

a hollow tubular body having a distal end, a distal port and a proximal port, wherein each of said ports is in fluid communication with a venous blood uptake lumen extending longitudinally within said body from said ports to a proximal portion of said body;

a distal vessel seat attached to said body, wherein said distal port is located nearer the distal end of said body than is the distal vessel seat; and

a proximal vessel seat attached to said body, wherein said proximal vessel seat is located nearer the distal end of said body than is the proximal port,

wherein said catheter is positionable within the vena cava of the mammal such that one vessel seat is positioned in the superior vena cava of the mammal between the right atrium and the junction of the brachiocephalic veins and the other vessel seat is positioned in the inferior vena cava between the right atrium and the hepatic veins,

whereby when the inferior and superior vena cavae of the mammal are seated against said vessel seats, venous blood flow from the vena cavae of the mammal is diverted into said ports and into said venous blood flow lumen.

45. The method of claim 44, wherein said venous blood flow lumen of said catheter is in fluid communication with an extracorporeal oxygenating device.

46. A method of diverting venous blood flow from the vena cavae of a mammal, said method comprising emplacing a superior caval return catheter within the superior vena cava of the mammal and emplacing an inferior caval return catheter within the inferior vena cava of the mammal, wherein each of said superior caval return catheter and said inferior caval return catheter comprises

a hollow tubular body having a distal end, a port, and a venous blood uptake lumen extending longitudinally within said body from said port to a proximal portion of said body; and

a vessel seat attached to said body, wherein said vessel seat is located nearer the distal end of said body than is said port,

wherein said superior caval return catheter is positionable within the superior vena cava of the mammal such that said vessel seat of said superior caval return catheter is positioned between the right atrium and the junction of the of the brachiocephalic veins, and

wherein said inferior caval return catheter is positionable within the inferior vena cava of the mammal such that said vessel seat of said inferior caval return catheter is positioned between the right atrium and the hepatic veins,

whereby when the inferior and superior vena cavae of the mammal are seated against said vessel seats, venous blood flow from the vena cavae of the mammal is diverted into said ports and into said venous blood flow lumens.

47. The method of claim 46, wherein said hollow body of at least one of said inferior caval return catheter and said superior caval return catheter has an access lumen extending from the distal tip of said body to the proximal portion of said body, and wherein said body further comprises at least one penetrable seal disposed within said access lumen for

permitting passage of a body through said seal while not permitting flow of venous blood through said access lumen from the distal tip to the proximal portion of said body.

48. The method of claim 47, wherein said penetrable seal comprises at least one balloon.

49. A method of providing an agent to a single compartment selected from the group consisting of the cardiac circulation of a mammal and the non-cardiac, non-pulmonary circulation of the mammal, said method comprising isolating the cardiac circulation from the non-cardiac, non-pulmonary circulation and providing the agent to said single compartment.

50. The method of claim 49, wherein said cardiac circulation is isolated from said non-cardiac, non-pulmonary circulation by

(1) inserting a caval catheter into the vena cava of the mammal, said caval catheter comprising

(a) a hollow tubular body having a venous blood flow lumen extending longitudinally therein, a proximal end, a distal end, a proximal port, and a distal port

(b) a distal vessel seat attached to said body; and

(c) a proximal vessel seat attached to said body,

wherein said catheter is positioned within the vena cava of the mammal such that one vessel seat is positioned in the superior vena cava between the right atrium and the junction of the brachiocephalic veins and the other vessel seat is positioned in the inferior vena cava between the right atrium and the hepatic veins,

wherein said distal port is located distally with respect to said distal vessel seat, and

wherein said proximal port is located proximally with respect to said proximal vessel seat,

(2) seating the vena cavae against said distal and proximal vessel seats,

(3) inserting an endoaortic catheter comprising an aortic vessel seat into the aorta of the mammal, and

(4) seating the aorta against the vessel seat,

whereby said cardiac circulation is isolated from said systemic circulation.

51. The method of claim 50, further comprising occluding the pulmonary artery of the mammal.

52. The method of claim 51, wherein the pulmonary artery of the mammal is occluded by threading a second catheter comprising an arterial vessel seat through a lumen extending longitudinally within said caval catheter, through an access port located between said vessel seats of said caval catheter, through the right atrium and right ventricle of the mammal's heart, and into the pulmonary artery of the mammal, and then seating the pulmonary artery against said arterial vessel seat.

53. The method of claim 50, further comprising occluding the azygous vein of the mammal.

54. The method of claim 49, wherein said cardiac circulation is isolated from said non-cardiac, non-pulmonary circulation by

(1) inserting a superior caval return catheter comprising a vessel seat into the superior vena cava of the mammal,

(2) inserting an inferior caval return catheter comprising a vessel seat into the inferior vena cava of the mammal,

(3) seating the superior vena cava against said vessel seat of said superior caval return catheter,

(4) seating the inferior vena cava against said vessel seat of said inferior caval return catheter,

(5) inserting an endoaortic catheter comprising an aortic vessel seat into the aorta of the mammal, and

(6) seating the aorta against the vessel seat,

whereby said cardiac circulation is isolated from said systemic circulation.

55. The method of claim 54, further comprising occluding the pulmonary artery of the mammal.

56. The method of claim 55, wherein the pulmonary artery of the mammal is occluded by threading a second catheter comprising an arterial vessel seat through a lumen extending longitudinally within one of said superior caval return catheter and said inferior caval return catheter, through the right atrium and right ventricle of the mammal's heart, and into the pulmonary artery of the mammal, and then seating the pulmonary artery against said arterial vessel seat.

57. The method of claim 54, further comprising occluding the azygous vein of the mammal.

58. The method of claim 49, wherein said agent is selected from the group consisting of a pharmaceutical composition, a composition comprising an imaging agent, and a gene vector.

59. The method of claim 58, wherein said gene vector is selected from the group consisting of an adenovirus vector and an adeno associated vector.

60. The method of claim 49, wherein at least one of said cardiac circulation and said non-cardiac, non-pulmonary circulation is connected with an extracorporeal oxygenating unit.

61. A method of providing an apparatus to a venous blood cavity of the heart of a mammal, said method comprising inserting at least one catheter into the vena cavae of the mammal, diverting blood flow from the vena cavae of the mammal, and providing said apparatus to said cavity,

wherein said catheter comprises at least two vessel seats positionable within the vena cavae of the mammal and has an access port, an access lumen extending longitudinally within said catheter from said access port to a proximal portion of said catheter, at least two blood uptake ports, and at least one venous blood flow lumen extending longitudinally within said catheter from said ports to the proximal portion of said catheter,

wherein blood flow through the vena cavae is diverted by seating the vena cavae against said vessel seats, whereby venous blood flows from the vena cavae, through said blood uptake ports, and into said venous blood flow lumen, and

wherein said apparatus is provided to said cavity by passing said apparatus through said access port by way of said access lumen and into said cavity.